

TITLE OF THE INVENTION

Method and Apparatus for Problem Solving, Decision Making
and Storing, Analyzing, and Retrieving Enterprisewide
Knowledge and Conclusive Data

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority under 35 U.S.C.
§119(e) to U.S. Provisional Patent Application No.
60/091,476, filed July 2, 1998, entitled ELECTRONIC TOOL,
and U.S. Provisional Patent Application No. 60/133,746,
filed May 12, 1999, entitled ELECTRONIC TOOL, both
incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR
DEVELOPMENT

Not Applicable

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BACKGROUND OF THE INVENTION

Modern business enterprises must address issues
surrounding the business in a systematic, often time-
driven, manner. Such business enterprises typically have
an organizational structure, often of a hierarchical or
matrix form, to define the various groups of individuals
responsible for a particular area of the business. Often a
particular issue evokes different concerns from different
groups, resulting in differing definitions of a problem to
be addressed. Further, individuals within the groups may
not have the knowledge, or expertise, to effectively

address a particular problem or decision, due to factors such as inexperience or lack of longevity in a particular role.

Lines of communication can become blurred when individuals assume they share a common understanding of a problem. The notion of a problem surrounding a complex situation can have different meanings to different groups or individuals within the business enterprise. The term "problem" is often used indiscriminately to define factors such as a complex situation requiring action, a malfunction or error, the cause of a malfunction or error, a difficult choice, or future trouble. Each of these concerns requires different action, yet all elements may be common to a particular situation. Prior to implementing action, such a situation must be broken down into a manageable set of issues which require action, and which can be verified as the correct set of issues which will resolve the situation.

Effectively addressing the issues presented by such a complex situation, therefore, requires clarification of the exact issues to be acted upon. However, as indicated above, different groups and/or individuals have different needs, and each may have a different definition of the problem, depending on how the complex situation affects the responsibilities of that group and/or individual. Further, employment terminations, transfers, and organizational changes can result in a lack of individuals with expertise and experience concerning such a complex situation. Such factors can cause a business enterprise to implement ineffective actions, perform duplicative acts, or even to implement actions which exacerbate the situation.

It would be beneficial to provide a computer software program adapted to provide an interactive interface to receive information surrounding such a complex situation, display such information in a format which allows the user to refine issues in a stepwise manner, and store such information, including both the solution or resolution and

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the thought processes that created them, for subsequent query and retrieval by multiple users for addressing future such complex situations.

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BRIEF SUMMARY OF THE INVENTION

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A computer software application, graphical user interface (GUI), and method for entering information concerning a complex business situation, refining such information in a stepwise manner through such an interface, generating a list of effective actions for addressing such a business situation, and storing such information in a knowledge base adapted for future query and reporting use for such complex business situations, is provided. A set or sequence of process screen structures allows entry of specific aspects of such a situation to generate such an action list. Such process screen sequences provide a systematic method to gather and organize information effectively in order to resolve a complex situation, and to store such information in a knowledge base for later query and retrieval for the same or similar situations, thereby preserving enterprisewide knowledge and expertise. An action tracker interface is also provided which provides task management and monitoring of the various actions determined by the process screen sequences. The user has the ability to access the process screens in a non-linear mode and can toggle between interview and worksheet modes described further below.

A situation appraisal process screen sequence provides a starting point in assessing a complex or ill-defined business situation. An interface for entering concerns presented by such a situation is presented to a user, and allows prioritization and categorization of such concerns. In this manner a user determines which concerns should be addressed first, and whether these concerns present a problem to be resolved, a decision to be made, or a potential problem which could result from a present plan or

decision. A list of actions to be undertaken by groups or individuals is defined through the action tracker interface to address the prioritized concerns, and includes an indication of which of the other process screen sequences should be undertaken: problem analysis, decision analysis, and/or potential problem/opportunity analysis.

A problem analysis process screen sequence provides an interface for entering information surrounding the problem in a selectively sequential, orderly manner, and for entering possible causes for the problem by drawing on the experience of the user and the knowledge base of past situations. Possible causes are then evaluated and eliminated in a prioritized manner to determine which possible cause explains the facts presented by the problem, and confirmed to be the true cause by verifying any questionable information pointing to the most probable cause. Actions and tasks needed to be undertaken to verify the most probable cause are assigned and monitored through the action tracker interface.

A decision analysis process screen sequence provides an interface to allow entry of a PURPOSE OF A DECISION based on specific lists of results sought, and entering alternatives which might satisfy each result. Alternatives are then considered with respect to each result. Various risks associated with each alternative are entered, and are ranked based on magnitude and probability. A decision choice is then determined by scrolling through and balancing the alternatives and risks. A decision analysis may be undertaken based on a situation appraisal, may be used to assess several possible causes resulting from a problem analysis, or may be undertaken independently. Actions needed to implement the decision are then entered and tracked using the action tracker interface.

A potential problem/opportunity analysis process screen sequence provides an interface to assess and determine actions to mitigate or eliminate future possible

problems and capitalize on opportunities which may arise during implementation of decisions and plans. This process screen sequence may be undertaken as indicated by a situation appraisal, may be used to evaluate a decision indicated by a decision analysis, or may be undertaken independently. Possible future problems or opportunities are identified and entered, and likely causes of each future problem are identified. Preventative actions which serve to reduce the likelihood of occurrence of each of the future problems are developed by scrolling through the likely causes, and contingent actions which may mitigate the result should the future problem occur despite the preventative action are also entered. Tasks required to implement the preventative actions and contingent actions are then entered and tracked using the action tracker interface.

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BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The invention as defined herein will be more fully understood by reference to the following drawings and detailed description of the drawings, of which:

Fig. 1 shows a top level functional block diagram;

Fig. 2 shows a system architecture block diagram;

Fig. 3 shows a flowchart of the situation appraisal process screen sequence;

Fig. 4 shows a flowchart of the problem analysis process screen sequence;

Fig. 5 shows a flowchart of the decision analysis process screen sequence;

Fig. 6 shows a flowchart of the potential problem analysis process screen sequence;

Fig. 7 shows the LIST THREATS AND OPPORTUNITIES screen of the Situation Appraisal screen sequence;

Fig. 8 shows the SEPARATE AND CLARIFY CONCERNS screen of the Situation Appraisal screen sequence;

Fig. 9 shows the CONSIDER SERIOUSNESS, URGENCY AND GROWTH screen of the Situation Appraisal screen sequence;

Fig. 10 shows the DETERMINE ANALYSIS NEEDED screen of the Situation Appraisal screen sequence;

5 Fig. 11 shows the DETERMINE HELP NEEDED screen of the Situation Appraisal screen sequence;

Fig. 12 shows the STATE THE PROBLEM screen of the Problem Analysis screen sequence;

10 Fig. 13 shows the SPECIFY THE PROBLEM screen of the Problem Analysis screen sequence;

Fig. 14 shows the USE DISTINCTIONS AND CHANGES screen of the Problem Analysis screen sequence;

Fig. 15 shows the STATE POSSIBLE CAUSES screen of the Problem Analysis screen sequence;

15 Fig. 16 shows the TEST POSSIBLE CAUSES AGAINST SPECIFICATION screen of the Problem Analysis screen sequence;

Fig. 17 shows the DETERMINE THE MOST PROBABLE CAUSE screen of the Problem Analysis screen sequence;

20 Fig. 18 shows the GATHER FACTS TO VERIFY THE TRUE CAUSE screen of the Problem Analysis screen sequence;

Fig. 19 shows the THINK BEYOND THE FIX screen of the Problem Analysis screen sequence;

25 Fig. 20 shows the STATE THE DECISION screen of the Decision Analysis screen sequence;

Fig. 21 shows the DEVELOP OBJECTIVES screen of the Decision Analysis screen sequence;

Fig. 22 shows the CLASSIFY OBJECTIVES INTO MUSTS AND WANTS screen of the Decision Analysis screen sequence;

30 Fig. 23 shows the WEIGHT THE WANTS screen of the Decision Analysis screen sequence;

Fig. 24 shows the GENERATE ALTERNATIVES screen of the Decision Analysis screen sequence;

35 Fig. 25 shows the SCREEN ALTERNATIVES THROUGH THE MUSTS screen of the Decision Analysis screen sequence;

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Fig. 26 shows the COMPARE ALTERNATIVES AGAINST THE WANTS screen of the Decision Analysis screen sequence;

Fig. 27 shows the IDENTIFY ADVERSE CONSEQUENCES screen of the Decision Analysis screen sequence;

5 Fig. 28 shows the MAKE THE BEST BALANCED CHOICE screen of the Decision Analysis screen sequence;

Fig. 29 shows the IMPLEMENT DECISION screen of the Decision Analysis screen sequence;

10 Fig. 30 shows the DEVELOP A PLAN screen of the Potential Problem Analysis screen sequence;

Fig. 31 shows the LIST POTENTIAL PROBLEMS screen of the Potential Problem Analysis screen sequence;

Fig. 32 shows the ASSESS THREATS screen of the Potential Problem Analysis screen sequence;

15 Fig. 33 shows the CONSIDER LIKELY CAUSES screen of the Potential Problem Analysis screen sequence;

Fig. 34 shows the TAKING PREVENTATIVE ACTION screen of the Potential Problem Analysis screen sequence;

20 Fig. 35 shows the TAKING CONTINGENT ACTION screen of the Potential Problem Analysis screen sequence;

Fig. 36 shows the MODIFY PLAN screen of the Potential Problem Analysis screen sequence;

Fig. 37 shows the ACTION TRACKER screen;

25 Fig. 38 shows the situation appraisal knowledge base ER diagram;

Fig. 39 shows the problem analysis knowledge base ER diagram;

Fig. 40 shows the decision analysis knowledge base ER diagram;

30 Fig. 41 shows the potential problem analysis knowledge base ER diagram;

Fig. 41a shows the potential opportunity analysis base ER diagram;

35 Fig. 42 shows the action tracker knowledge base ER diagram;

Fig. 43 shows the general process screen sequence class inheritance graph;

Figs. 44a-44c show the situation appraisal class inheritance graph;

5 Figs. 45a-45d show the problem analysis class inheritance graph;

Fig. 46 shows the decision analysis class inheritance graph;

10 Fig. 47 shows the potential problem analysis class inheritance graph;

Fig. 47a shows the potential opportunity analysis class inheritance graph;

Fig. 48 shows the action tracker class inheritance graph;

15 Fig. 49 shows the DEVELOP A PLAN screen of the Potential Opportunity Analysis screen sequence;

Fig. 50 shows the LIST POTENTIAL OPPORTUNITIES screen of the Potential Opportunity Analysis screen sequence;

20 Fig. 51 shows the ASSESS BENEFITS screen of the Potential Opportunity Analysis screen sequence;

Fig. 52 shows the CONSIDER LIKELY CAUSES screen of the Potential Opportunity Analysis screen sequence;

25 Fig. 53 shows the TAKING PROMOTING ACTION screen of the Potential Opportunity Analysis screen sequence;

Fig. 54 shows the TAKING CAPITALIZING ACTION screen of the Potential Opportunity Analysis screen sequence;

Fig. 55 shows the MODIFY PLAN screen of the Potential Opportunity Analysis screen sequence;

30 Fig. 56 shows a GUI screen indicative of the top-level menu as illustrated in Fig. 1;

Figs. 57-73 show an alternative embodiment of the GUI screens of the situation appraisal process screen sequence;

35 Figs. 74-84 show a first alternative embodiment of the GUI screens of the problem analysis process screen sequence; and

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Figs. 85-137 show a second alternative embodiment of the GUI screens of the problem analysis process screen sequence.

5 DETAILED DESCRIPTION OF THE INVENTION

10 The top level functional block diagram of the complex situation assessment process screen sequences 10 as defined herein is shown in Fig. 1. Situation appraisal 12 is typically most applicable to an initial assessment and enumeration of concerns surrounding a situation. This appraisal results in an indication of which of the process screen sequences, problem analysis 14, decision analysis 16, or potential problem/opportunity analysis 18, is most applicable to a particular concern. Each of the three analysis process screen sequences 14, 16, 18 may also be invoked independently irrespective of a corresponding situation analysis. Action tracker interface 20 is available from all process screen sequences, and may also be invoked independently.

20 Fig. 2 shows an architectural block diagram of the system in which the situation assessment process screen sequences are invoked. Software architecture 23 as included, for example, in workstation 22 includes the process components 24 which comprise the situation appraisal, problem analysis, decision analysis, and potential problem/opportunity analysis software which drive the process screen sequences. Action tracker component 26 comprises software driving the action tracker, accessible from any of the process screen sequences. Knowledge base access and retrieval of prior situation assessment activities are performed by report writer component 28, for broad queries and retrieval of large quantities of data, and keyword query or other searching component 30, for pinpointing specific entities and situations. Other support and administrative functions are provided by

licensing management component 32, system support component 34, and administrative component 36.

Workstation 22 is networked to remote users 38, for enterprisewide access at remote locations, and local network server 40, for accessing the knowledge base 42 to store and retrieve prior situation assessment data. Archive database 44 and client database 46 are for backup functions and enterprise specific information, respectively.

10 The software as described above is executed on a device such as workstation 22. In this embodiment, workstation 22 is a 32 bit microprocessor-based system such as a PENTIUM® PC and executes on a WINDOWS® (94, 98, or NT) platform or other operating system as compiled. 16 bit users may utilize commercially available extensions for use on older PCs. 32M main memory is recommended, however execution may be possible with less memory with lower performance.

20 The process screen sequences defined further below are point and click WINDOWS®-type graphical user interfaces common to many computer applications. Screens are scrolled through using common scroll arrow buttons, and pull-down menus may be used to jump between various screens in a particular screen sequence. A user may begin with any process screen sequence, also through a pull-down menu, although it is expected that a situation appraisal will precede one or more of the other process screen sequences. Each process screen sequence is identified by a unique process identifier or file name for later retrieval and knowledge base entry. Entry cells are either for free form entry of descriptive text, or pull-down menus to populate the field from among a list of finite choices. A user may elect either a worksheet mode or interview mode of operation. Worksheet mode is for the experienced user, and 35 allows unprompted entry of data into the relevant fields to expedite the assessment. Interview mode is a more

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user attempts to advance to a next screen, after completing entry on the current screen, however could also be provided upon entry of a particularly suspect cell. A COMMON PITFALLS process checker flags areas where imprecise data will result in later difficulty, as with critical data items. Such messages are displayed prior to user input as a reminder, and do not analyze data after entry. A SHARPENER process checker assists in entry of critical fields where further prompting assists in refining the response. A series of questions is presented to the user to assist in editing the response entered in the cell. This process checker, therefore, guides the user through a series of successively narrower questions in order to pinpoint accurately the desired item of information. All process checkers may be overridden by the user once confirming that the response entered is in fact correct.

Cells as presented by the process screen sequences defined herein may be populated via direct text entry from the keyboard, or may be populated and/or supplemented by attaching an external file. These files are stored in the knowledge base and remain associated with the particular cell or record. Such files may be MICROSOFT® Word Documents, POWER POINT® files, jpegs, bitmaps, AUTOCAD® files, or other external file appropriate to the particular cell.

Flowcharts for exemplary situation appraisal, problem analysis, decision analysis, and potential problem analysis process screen sequences are shown in Figs. 3-6. Each of the steps in the flowcharts corresponds to a specific screen in the sequences described in further detail below. Specifically, Fig. 3 shows a situation appraisal flowchart 50; Fig. 4 shows a problem analysis flowchart 52; Fig. 5 shows a decision analysis flowchart 54, and Fig. 6 shows a potential problem analysis flowchart 56.

Software architecture is based upon various third-party toolkits and development platforms consistent with modern industry development standards to facilitate modifications and extensions. Unified Modeling Language (UML) is employed to standardize the object-oriented architecture. COM objects are provided where appropriate, to facilitate integration and modification. Rational Rose Modeler for software design, ERWin® for database modeling, and Delphi Client/Server are used to facilitate future enhancements.

SITUATION APPRAISAL

The situation appraisal screen sequence 50 provides a user interface which allows a situation to be subdivided into a set of specific concerns so that a user may graphically organize and clarify issues to be resolved. Each situation is stored in an individual situation file for later retrieval and database indexing. A situation background and theme are also provided to set the general business context and to be used as a reference or refresher for later querying and retrieval.

Once the situation file is created, the threats and opportunities screen, shown in Fig. 7, is then used to enter broad issues relating to general concerns of the situation. Users enter descriptive text for each broad issue in concern cells 100, which scroll downward to accommodate all the broad issues entered. Once complete, the ADVANCE SEQUENCE arrow button 102 is used to progress to the separate and clarify concerns screen shown in Fig. 8. Users then consider the broad issues entered in the previous screen, and clarify and refine them into distinct concerns in refined concern cells 104, removing redundant items and consolidating overlapping issues. When the modified list describes distinct refined concerns, rather than broad issues, ADVANCE SEQUENCE arrow 102 is used to progress to the concern consideration screen.

5 The concern consideration screen shown in Fig. 9
allows a user to enter specific information for each of the
stored refined concerns 104 stemming from a particular
situation, as listed on the separate and clarify concerns
screen. This provides an interface to populate various
cells addressing the seriousness 106, urgency 108, and
growth 110, defined further below, of a particular
situation, thereby allowing computation of a priority 112
for that concern. The CONCERN CONSIDERATION screen is used
10 to refine details of each concern. Some of these cells are
further subdivided into a specification, for descriptive
text, and a relativity field, for ranking relative to other
concerns.

15 The priority cell 112 is computed based on the
relativity fields for seriousness, urgency, and growth,
described further below, to provide an overall ranking of
concerns. Alternatively, this cell may be overridden by
the user through priority pull-down 112.

20 The SERIOUSNESS cell 106 is further divided into a
specification cell 126 and a relativity cell 116. Users
enter descriptive text in the specification cell 126 to
describe the impact the concern in question will have with
respect to human resources, safety, cost, customers,
productivity, reputation, and other factor which affect the
25 enterprise. The seriousness relativity cell 116 is for
entering a discrete ranking of magnitude relative to the
seriousness of other concerns. A ranking hierarchy such as
high (H), medium (M), low (L), and need more data (NMD) can
be entered here through a pull-down menu similar to the
30 priority cell, and will be displayed as well as used in
calculating priority.

35 The URGENCY cell 108 also has two components, a
specification cell 128 and a relativity cell 118. The
urgency specification cell 128 is for descriptive text
directed to determining when resolution of this concern
would become difficult, expensive, or impossible. The

urgency relativity cell 118 is for entering a discrete ranking of magnitude relative to the urgency of other concerns, similar to the priority cell pull-down.

5 The GROWTH cell also has specification and relativity components. Specification cell 130 is for descriptive text directed to determining the evidence that the seriousness of the concern will grow. The growth relativity cell 120 is for entering a discrete ranking relative to growth potential of other concerns, similar to the priority cell
10 pull-down. High (H) indicates that the growth potential is increasing, medium (M) indicates that the growth potential is stable, and low (L) indicates that growth is decreasing. Need more data (NMD) may also be entered.

15 Once all concerns 104 relevant to the situation are entered, screen sequence button 102 is used to advance to the determine analysis needed screen in Fig. 10. For each concern entered, five clarifying cells are provided: PRIORITY, SERIOUSNESS, URGENCY, GROWTH, and PROCESS. Each concern cell entered on the previous screen is displayed,
20 along with a PROCESS cell 140 for each concern. PROCESS cell also has specification 144 and a relativity components 142. Process relativity cell 142 is for entering the specific process sequences, described further below, that should be used to address each concern, and is selected by
25 pull-down menu 146. A problem analysis sequence should be undertaken if the concern is directed to the cause of why a particular event or occurrence happened. A decision analysis sequence should be undertaken if the concern is directed to determining the course of action that should be
30 pursued to address the concern. A potential problem analysis should be undertaken if the concern is directed to predicting future occurrences or events and possible remedial action to be taken. A further situation appraisal should be undertaken if the concern is too broad to be
35 adequately addressed by the problem, decision, or potential problem analysis sequences.

After an analysis is selected for each concern, the DETERMINE HELP NEEDED screen (Fig. 11) is used to identify specific individuals or groups to execute the analysis determined in the previous screen and to identify the specific objective of the analysis. The DETERMINE HELP NEEDED screen has a PROCESS section 150, which echoes information from the DETERMINE ANALYSIS screen, and an ASSIGNMENT section 152, for specifying involvement of other people. The ASSIGNMENT section 152 is integrated with the action tracker, described further below, which provides scheduling for all screen sequences. ACTION cell 154 is used to enter descriptive text for the task and objective. This task is generally an "analysis" from the determine analysis screen, or other task for addressing a particular concern. WHO cell 156 is a pull-down menu of names for assignment to the analysis, and also allows for entry of new names. WHEN cell 158 indicates the completion date of the analysis. NOTES cell 160 is a descriptive text cell which can contain clarifying or specification information of the analysis, such as product, assembly line, or plant location. STATUS cell 162 is used to describe the current state of the task, and is a pull-down with the options not started, action assigned, cancelled, on hold, cause confirmed. Other status cell values may be entered. Sort pull-down 164 allows sorting by any of the ASSIGNMENT section cells. The result of this process screen sequence is that the user is provided with an indication of which of the analysis process screen sequences, problem, decision, or potential problem, are most applicable to the concern in question, as described further below.

PROBLEM ANALYSIS

The problem analysis screen sequence provides a user interface which allows a problem to be subdivided into a set of statements which describe various aspects of the problem and what they are and are not, creating a concise,

accurate problem specification. These statements are then assigned possible causes. The possible causes are then evaluated to determine the most probable cause and verify the most probable cause to determine if it is the true cause.

A problem background statement concerning the context is read from the situation appraisal file to which this problem analysis corresponds. This statement may be edited by the user or alternately, entered entirely by the user. This problem background statement is then stored in an individual problem analysis file for later retrieval and database indexing.

Referring to Fig. 12, the STATE THE PROBLEM screen is used to enter a statement of normal operation in the SHOULD BE HAPPENING cell 200 to describe what the object of the problem should be doing when performing properly. ACTUALLY HAPPENING cell 202 is then used to enter a perceived problem, which is the current condition of the object that is believed to be, or have, the problem. User then selects the applicable cause known/unknown button. If the cause is known, button 211 is selected, and the user is prompted that a problem analysis is not appropriate and an alternate screen sequence, such as decision analysis, may be applied. If the cause is not known, button 210 is selected, and the object of the problem is then entered in OBJECT cell 206, such as "motor", "assembly line five", or "Boston office". The DEVIATION cell 208 is used to enter the deviation from normal operation, such as "cracked housing" or "sales down ten percent".

The user then advances to the SPECIFY THE PROBLEM screen, for example as shown in Fig. 13, to enter specific statements of fact concerning the problem. A concise problem statement 212 from the object 206 and deviation 208 cells is carried over from the previous screen, and is the concatenation of the object and deviation cells to form a statement such as "Boston office sales down ten percent."

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to the USE DISTINCTIONS AND CHANGES screen shown in Fig. 14, which provides cells for entering distinctions between each of the IS/IS not descriptors entered previously. These distinction fields assist in entering possible causes (Fig. 15). Alternatively, if the user prefers using their own knowledge and experience, they may advance directly to the STATE POSSIBLE CAUSES screen.

The USE DISTINCTION AND CHANGES screen (Fig. 14) presents the user with the previously entered problem statement 212 and descriptor question cells 214, and provides, for each descriptor question, DISTINCTION 224 and CHANGE 226 cells. These DISTINCTION and CHANGE cells are for entering descriptive text to identify the distinctive features concerning the "IS" data 216 relative to the "IS NOT" data 218, for each of the descriptor questions 214. The information in these cells assists in identifying possible causes in the subsequent state possible causes screen (Fig. 15). Users enter distinctive features for each is/is not pair in DISTINCTION cells 224. Multiple distinctive features may be entered by clicking insert button 228 to insert a DISTINCTION cell. Not all descriptor IS/IS NOT cells need be populated, however a distinction may not be entered unless the corresponding descriptor question cells are populated. Descriptor IS/IS NOT cells may be entered here as well.

For each DISTINCTION cell 224, descriptive text concerning changes are entered in CHANGE cells 226. Such changes may be those that have occurred in, on, around, or about each distinction, in order to identify possible causes. Other changes may also be used. As with DISTINCTIONS 224, multiple change cells may be entered for each distinction by clicking the INSERT CHANGE button 230.

The user next advances to the STATE POSSIBLE CAUSES screen shown in Fig. 15. This screen has two formats depending on whether the user has elected to enter distinctions and changes. Fig. 15 shows the STATE POSSIBLE

5 descriptive text is entered in possible CAUSE cells based upon the information in the DISTINCTION/CHANGE cells 224, 226 or is/is not responses 216, 218, as applicable. The most effective possible causes tend to be provided by cross-correlating the eleven different descriptor questions
10 to find common denominators and items which are mutually exclusive. Additional possible cause cells may be added through INSERT POSSIBLE CAUSE button 234.

15 screen shown in Fig. 16. This screen presents possible causes one at a time in POSSIBLE CAUSE cell 236. The possible cause selection buttons 238 are used to scroll through the list of previously entered possible causes. The problem statement 212 is echoed here, as well as the
20 descriptor questions 214 and responses 216, 218. A CONDITIONS 240 cell and an ASSUMPTIONS cell 242 are provided for user input. For each possible cause 236, users scan the list of descriptor questions 214. For each descriptor question, conditions 240 under which the
25 possible cause would prove or disprove the descriptor question are entered. Conditions are entered under prefixes such as "ONLY IF", "YES BECAUSE", and "NO BECAUSE" via condition pull-down 244. Assumptions pertinent to the basic condition are then entered in ASSUMPTIONS/NOTES cell
30 242. An "ONLY IF" assumption specifies the specific circumstances under which the possible cause would explain the particular descriptor question 214. A "YES BECAUSE" assumption explains why the possible cause would explain the particular descriptor question. A "NO BECAUSE"
35 assumption explains why the possible cause could not explain the particular descriptor question 214, and

5 an eliminated possible cause, however, and the associated assumption, is nonetheless retained in the knowledge base for subsequent queries, described further below with respect to the knowledge base query engine. Multiple ASSUMPTIONS/NOTES cells 242 needed to explain a particular
10 descriptor question may be entered through INSERT ASSUMPTION button 246.

15 (Fig. 17). At this point the list of possible causes has
been narrowed due to elimination of the possible causes
resulting in a "NO BECAUSE" condition test, above. This
screen presents remaining assumptions entered on the TEST
POSSIBLE CAUSES screen (Fig. 16) in an ASSUMPTION cell 242,
20 alongside the corresponding POSSIBLE CAUSE cell 236. For a
listed possible cause, probability pull-down 247 may be
used to assign a probability cell 248 from among: MPC (most
probable cause, high (consider next), medium (also verify)
and low (consider later). The ASSUMPTION cells 242 and
25 POSSIBLE CAUSE cells 236 are sorted according to the
probability 248 and the condition (244, Fig. 16) for use in
the next screen.

not carried over onto this screen, however such causes and assumptions are nonetheless stored in the knowledge base for later query use. The remaining possible causes and their respective assumptions are displayed in their respective cells 236, 246. Individual possible causes are considered by the user in a scrolling format which allows the user to advance through scroll buttons 248 from most

probable to the "ALSO VERIFY" possible causes. For each possible cause 236 presented, ACTION TRACKER cells 250 are used to enter actions needed to resolve the possible cause 236 and the accompanying assumptions 246. ACTION cell 252 is for descriptive text indicative of the specific test, activity, or question to be undertaken in order to confirm or deny a particular possible cause and the assumptions associated therewith. WHO cell 254 is for indicating the person or group responsible for the action, and WHEN cell 256 is for a completion date. NOTES cell 258 allows entry of descriptive text concerning other aspects of the action.

ACTION TRACKER cells 250 are integrated with the action tracker, described further below, which is integrated with the other process screen sequences as defined herein. In this manner, a concise itemization of the actions required to address a particular possible cause can be entered, stored in the knowledge base, and later searched and retrieved through the query engine, in addition to being codified for tracking the present problem. The query engine, described further below, may also be invoked to search for similar possible causes in the knowledge base. Resolution of the action items should then focus and refine the remaining possible causes to determine the true cause.

Fig. 19 shows the THINK BEYOND THE FIX SCREEN for entering data to enumerate ramifications of the actions just entered. This information may be useful in the potential problem analysis process screen sequence, described further below.

DECISION ANALYSIS

A situation appraisal, as described above, may also indicate that a decision analysis is warranted. A decision analysis, as described further below, allows a user to populate cells specifying objective aspects of the decision, and use these cells for reporting and querying of

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weight. The most compelling objective is assigned a value of ten on a zero to ten scale, however the upper limit could be varied to suit the granularity desired as can the scale itself. The user then considers each remaining objective and assigns a relative weight accordingly.

Following the WEIGHT THE WANTS screen, the user progresses to the generate alternatives screen shown in Fig. 24. This screen is for generating alternatives based on the previously entered objectives. MUST and WANT objectives are displayed in MUST OBJECTIVES cell 322 and WANT OBJECTIVES cell 324. Want objectives may be sorted by relative weight cell 318 value, or may remain in the order entered. The user scrolls through the MUST and WANT objectives to generate alternatives, and enters these alternatives in ALTERNATIVE cell 326. The user may scroll through the objectives in any order. However, considering the MUST objectives first ensures that mandatory items are reflected in the resulting alternatives list. Additionally, users may query the knowledge base for previously entered alternatives using query engine, described further below. Additional alternatives may be entered by clicking INSERT ALTERNATIVES button 328. Objectives may also be added by clicking insert MUST OBJECTIVE button 330 and insert WANT OBJECTIVE button 332. Once all alternatives are entered, the user advances to the screen alternatives through the musts screen, shown in Fig. 25, to refine and narrow the entered alternatives.

On screen alternatives through the MUSTS screen (Fig. 25), the MUST OBJECTIVES 322 and the ALTERNATIVES 326 are displayed in a matrix form for review and selection. Scroll bars 336 and 334 can be used for horizontal scrolling through the alternatives and vertical scrolling through the must objectives, respectively. A FEASIBILITY cell 338 is therefore provided corresponding to each alternative and must objective. Descriptive text to describe how an alternative does or does not meet a must

objective is entered by the user in descriptive portion 340. Each FEASIBILITY cell 338 also has a GO/NO GO toggle button 342 to provide a discrete indication of whether an alternative satisfies a particular must objective. An
5 alternative with even one "no go" attributed to it is deemed eliminated and is not carried forward. However, it will be retained in the knowledge base for later query and retrieval.

Following consideration of MUST objectives, the
10 COMPARE ALTERNATIVES AGAINST THE WANTS screen (Fig. 26) is entered. This screen is provides a WANT ALTERNATIVE slider 344 to rank alternatives, such as on a 1-10 scale, rather than a discrete GO/NO GO toggle. Previously entered want weight 318 is also displayed for reference. For each want
15 objective/alternative combination, a FEASIBILITY cell 340 is provided to describe the alternative with respect to the objective. Each WANT OBJECTIVE 304 is compared to ALTERNATIVES 326. The alternative which best satisfies the want objective receives a score 346 value of ten, or
20 highest, using slider 344. The other alternatives for that WANT OBJECTIVE 324 are scored relative to the alternative which received the score of ten.

Once the ALTERNATIVES 326 are scored, a weighted score for each objective 324 is computed and displayed. The
25 weighted score is the result of the weight value assigned the objective multiplied by the score value assigned to this alternative. The total weighted scores then indicate which alternatives best satisfy the objectives. Also provided is a total alternative score 348 for each
30 alternative, which serves as an indicator of the alternatives having a greater overall impact. A tentative choice button 350 is clicked to indicate which alternatives are selected by the user, which need not be the alternatives having the highest total alternative score
35 348.

Following the scoring of the alternatives, risks associated with each alternative selected for further evaluation are considered on the identify adverse consequences screen (Fig. 27). The remaining alternatives are displayed in descending order by total alternative score, one at a time in alternatives cell 326, along with the corresponding total alternative score cell 348. Users scroll through the alternatives carried over from the previous screen using alternative selection buttons 352.

As each alternative is displayed, users identify a possible adverse consequence 353 which could result from this alternative. The user enters descriptive text in "if" cell 354 to define the condition under which the adverse consequence could occur. Probability cell 356 is a pull-down of choices such as low, medium, and high, indicative of the probability that the adverse consequence will occur. "Then" cell 358 is for descriptive text concerning the result of the adverse consequence occurring, and seriousness cell 360 is a pull-down with the options low, medium, and high indicative of the magnitude of the result should the adverse consequence occur. Notes cell 362 is for descriptive text concerning other information about the condition or result for further clarification or later query. Multiple consequences for an alternative may be entered through INSERT adverse CONSEQUENCE button 364.

Fig. 28 shows the MAKE THE BEST BALANCED CHOICE screen. This screen is used to select one alternative as a decision by displaying cells for the ADVERSE CONSEQUENCES 353 carried over from the previous screen, the total alternative score cell 348, and the want OBJECTIVES cell 324, entered previously. Mandatory "MUST" objectives have already been considered by eliminating the alternatives which do not satisfy them. Accordingly, the adverse consequence cells 353, WANT OBJECTIVE cells 324, and ALTERNATIVES cells 326, may now be scrolled through to evaluate the elements of each available alternative 326.

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Additional want objectives or adverse consequences may also be entered on this screen by clicking on INSERT WANT OBJECTIVE button 366 or INSERT ADVERSE CONSEQUENCE button 368, respectively. The chosen alternative is marked as a final decision by DECISION checkbox cell 370.

Following selection of final decision, the IMPLEMENT DECISION screen is displayed (Fig. 29). This screen displays the final decision 372 as chosen on the previous screen from the most appealing alternative 326, and further provides ACTION TRACKER cells for ACTION 376, WHO 378, WHEN 380, and NOTES 382. These cells provide input to the ACTION TRACKER, and are used similarly to the action tracker cells in the other screen sequences. Actions required to implement or complete the chosen decision are assigned to groups or individuals, scheduled, and tracked using the action tracker, described further below.

POTENTIAL PROBLEM ANALYSIS

Once a decision is made, the implementation of that decision may nonetheless encounter problems. The potential problem analysis screen sequence is used to enter and organize events and/or occurrences which may hinder the implementation of action plans. This screen sequence may be pursued following entry of ACTION TRACKER cells after a decision analysis or other process screen sequence, above, or may be undertaken alone with respect to an independent course of action.

Referring to Fig. 30, the DEVELOP A PLAN screen is shown. An action statement defining a specific and concise purpose of the action, task, or project is entered in ACTION STATEMENT cell 400. This statement may be carried over or modified from a decision analysis, or may be entered as free form text. A set of ACTION cells 402 is provided, which may be populated from an action tracker file or entered by the user. ACTION PLAN cell 404, NOTES cell 406, WHO cell 408, and WHEN cell 410 are used as in

other process screen sequences to enter actions or tasks, clarifying notes, responsible groups or individuals, and due dates, respectively, and are described with the action tracker description below. Additional ACTION cells may be entered by clicking on INSERT ACTION button 412.

List potential problems screen (Fig. 31) is then used to view each ACTION cell 403 individually, and enter potential problems which could be raised by the specific action in POTENTIAL PROBLEMS cell 416. The POTENTIAL PROBLEMS cell allows entry of a concise statement to respond to important areas of the corresponding action. This sequence therefore allows entry of specific, concise potential problems corresponding to a particular action for later analysis. Scroll buttons 414 are used to advance through the ACTION cells 402 to review each action.

After the user has entered the potential problems for the actions, the ASSESS THREATS screen (Fig. 32) is used to identify potential problems which require the most attention, and those which are unlikely to have a serious impact. The potential problems list entered on the previous screen therefore prioritizes the list to identify potential problems requiring attention first. ACTION STATEMENT cell 400 echoes the action statement. ACTION cell 403 lists the ACTION plan 404, NOTES 406, WHO 408, and when 410 cells individually, and may be scrolled using scroll buttons 414. For each ACTION cell 403, the potential problems associated with that action are listed in POTENTIAL PROBLEM cells 416. For a potential problem, the user enters a PROBABILITY cell 418, and a SERIOUSNESS cell 420. PRIORITY cell 422 is computed based on the values of the seriousness and probability cells after potential problems have been assigned values. PROBABILITY cell 418 is a pull-down with comparative values such as low, medium, and high. For each potential problem the user evaluates the probability of occurrence and enters a value accordingly. Similarly, SERIOUSNESS cell 420 is a low,

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zero. TAKING CONTINGENT ACTION screen (Fig. 35) is used to enter actions which can minimize the effect if a particular potential problem nonetheless occurs. CONTINGENT ACTION cells 439 are used to enter such actions. Since such actions are only necessary if the potential problem occurs, TRIGGER cell 440 is used to specify the system, person, or event to invoke the particular contingent action. The information in TRIGGER cell 440 therefore contains information identifying the event that triggers and commences the contingent action to provide a rapid response to a particular potential problem. Additional CONTINGENT ACTION cells 439 and TRIGGER cells 440 may be added through the respective buttons 442, 444.

MODIFY PLAN screen (Fig. 36) is then used to review the action cells along with the preventative and contingent actions entered in this screen sequence. Upon finalization of the action plan, update ACTION TRACKER button 446 is used to store the information in the knowledge base where it is available to other process screen sequences as described further below with respect to the action tracker.

POTENTIAL OPPORTUNITY ANALYSIS

Once a decision is made, the implementation of that decision may provide additional opportunities. The potential opportunity analysis screen sequence is used to enter and organize events and/or occurrences which may offer opportunities in the implementation of action plans. This screen sequence may be pursued following entry of ACTION TRACKER cells following a decision analysis or other process screen sequence, above, or may be undertaken alone with respect to an independent course of action.

Referring to Fig. 49, the DEVELOP A PLAN screen is shown. An action statement defining a specific and concise purpose of the action, task, or project is entered in ACTION STATEMENT cell 900. This statement may be carried over or modified from a decision analysis, or may be

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probability cells after potential opportunities have been assigned values. PROBABILITY cell 918 is a pull-down with comparative values such as low, medium, and high. For each potential problem the user evaluates the probability of occurrence and enters a value accordingly. Similarly, BENEFIT cell 920 is a low, medium, high pull-down which is set according to the magnitude of the result should the potential opportunity occur. In this manner, the user can identify potential opportunities which represent an acceptable amount of benefit, and those that need to be acted upon. INSERT OPPORTUNITY button 924 can be used to add additional potential opportunities.

The CONSIDER LIKELY CAUSES screen (Fig. 52) is next used to enter likely causes of each of the potential opportunities. Each potential opportunity is displayed in POTENTIAL OPPORTUNITY cell 926, along with the corresponding PRIORITY cell 922. In this manner, the user can elect to only address potential opportunities having a certain priority, high or medium, for example, and deem the others to represent a lower priority benefit. For each potential opportunity chosen to be addressed, a LIKELY CAUSE cell 928 is provided for entering a concise statement of the actions, occurrences, or other events which might result in the potential opportunity. Multiple likely causes may be entered for each potential problem opportunity. A CAUSE PROBABILITY cell 930 is also provided to describe the probability of the cause occurring. CAUSE PROBABILITY pull-down 932 is used to enter a discrete comparative value such as low, medium, or high, while PROBABILITY notes portion 934 is used for descriptive text describing the probability. Additional likely causes attributed to a potential problem may be added through INSERT LIKELY CAUSE button 936.

The TAKING PROMOTING ACTION screen shown in Fig. 53 is then used to enter one or more PROMOTING ACTION cells 938 corresponding to a particular likely cause. A promoting

action to serve as a barrier against the likely cause is entered in this cell 938. CAUSE PROBABILITY cell 930 from the previous screen may be used to assess higher benefit likely causes first, or to no longer consider a low probability likely cause.

Despite robust promoting actions, it is unlikely that the chance of a likely cause occurring can be increased to be a certainty. TAKING CAPITALIZING ACTION screen (Fig. 54) is used to enter actions which can maximize the effect if a particular potential opportunity occurs, whether caused by the promoting action or not. CAPITALIZING ACTION cells 939 are used to enter such actions. Since such actions are only necessary if the potential opportunity occurs, TRIGGER cell 940 is used to specify the system, person, or event to invoke the particular capitalizing action. The information in TRIGGER cell 940 therefore provides an enumeration to provide a rapid response to a particular potential opportunity. Additional CAPITALIZING ACTION cells 939 and TRIGGER cells 940 may be added through the respective buttons 942, 944.

When the capitalizing actions and triggers have been identified, it is often necessary to take preparatory actions that set the capitalizing actions and/or triggers in place before the potential opportunity might occur, and to remove the capitalizing actions and triggers after the potential opportunity could no longer occur.

MODIFY PLAN screen (Fig. 55) is then used to review the action cells along with the promoting and capitalizing actions entered in this screen sequence. Upon finalization of the action plan, update ACTION TRACKER button 946 is used to store the information in the knowledge base where it is available to other process screen sequences as described further below with respect to the action tracker.

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ACTION TRACKER

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The action tracker interface is used to store, identify and compare tasks, responsible individuals or groups, due dates, and other logistical information associated with the various process screen sequence defined herein. The action tracker can be updated directly, or through action tracker data entered during the process screen sequences. Referring to Fig. 37, the ACTION TRACKER master screen is shown. This screen is similar to the ACTION TRACKER entry screen in the other process screen sequences. ACTION FILE cell 500 is used to select a previously entered action file for review and/or update. Action files on users systems across the network are listed here for various action files resulting from the process screen sequences described above. In this manner, enterprisewide monitoring of the various process screen sequences being undertaken is provided. REFRESH button 503 can be used to update the action tracker master screen with any new information entered by a user concerning a process screen sequence.

CONCERN cells 502 in the ACTION FILE 504, that can also be implemented in the other processes, list the concerns stored in the ACTION FILE 504 selected. Each concern is evaluated by criteria such as: urgency, growth, and seriousness, and is specified along a scale through a pull-down menu. A fourth cell, PRIORITY, is computed based on the values of the other three. SERIOUSNESS cell 506 is for entering a discrete ranking of magnitude relative to the seriousness of other concerns, and has a value of High (H), medium (M), low (L), and need more data (NMD). URGENCY cell 508 is rated based on a determination of when resolution of this concern would become difficult, expensive, or impossible, and has a value of low, medium, or high. GROWTH cell 510 is for indicating the potential that the seriousness of the concern will grow. PROCESS cell 512 is for specifying which of the process screen

sequences applies to this concern: situation appraisal, problem analysis, decision analysis, or potential problem analysis. CONCERN SORT pull-down 514 allows the CONCERNS 502 from the action file to be sorted by various fields such as concern, process, or priority. VIEW BY pull-down 527 allows a user to view all concerns in the action file, or only those specific to a certain individual, such as all concerns to which the user is attributed an action.

Clicking on a CONCERN cell 502 displays all actions currently entered for that concern in the ACTION cells 516, for review and/or modification. Additional actions may be added to those uploaded from the action file. WHO cell 518 specifies the group or individuals responsible for executing the task specified in the action cell, and may be modified through a pull-down list of names and groups. Multiple names may be entered, and new names not in the pull-down may be added. WHEN cell 520 indicates the expected completion date of the action. STATUS cell 524 provides a discrete indication of milestones reached concerning the action, such as not started, in progress, late, action assigned, cancelled, on hold, cause confirmed. Additional status milestones may be added. NOTES cell 522 contains descriptive text concerning other information. ACTION SORT pull-down 526 allows the listed actions to be sorted by various fields such as ACTION, WHO, WHEN, NOTES, or STATUS. Actions may automatically be mailed electronically to others, including to recipients who are not users of the system. Alternative screen formats for the various GUI screens disclosed herein are listed in Figs. 56-137.

KNOWLEDGE BASE STRUCTURE

An entity-relationship (ER) diagram of the knowledge base accumulated through the various process screen sequences as defined herein is shown in Figs. 38-42. In addition, the knowledge base links process applications and

tracks changes made on a user-by-user basis.

5 Situation appraisal ER diagram is shown in Fig. 38, and contains cells for storing the information entered in the cells during the situation appraisal process screen sequence. CONCERN 600, PRIORITY 602, and the PROCESS 604 to be used for further analysis are stored in refined CONCERN entity 606. ACTION TRACKER cells WHO 608, ACTION 610, and WHEN 612 are stored in INVOLVEMENT entity 614.

10 Fig. 39 shows the problem analysis ER diagram, and contains cells pertinent to the problem analysis process screen sequence. SHOULD BE HAPPENING 616, ACTUALLY HAPPENING 618, OBJECT 620, and DEVIATION 622 are stored in PROBLEM entity 624. IS/IS not cells are stored in RESPONSE entity 626. DISTINCTIONS 628 are stored in DISTINCTIONS
15 entity 630. CHANGES 632 are stored in CHANGES entity 634. POSSIBLE CAUSES 636 are stored in PROBABLE CAUSES entity 638. CONDITIONS AND ASSUMPTIONS 640 are stored in TEST RESPONSES entity 642. CONFIRMED TRUE CAUSE 644 is stored in BEYOND FIX 646. ACTION TRACKER cells are stored in
20 CAUSE ACTIONS entity 648.

Fig. 40 shows the decision analysis ER diagram. BACKGROUND 650 and STATEMENT 652 are stored in DECISION ENTITY 654. SCORES 656 for the various alternatives are stored in ALTERN 658.

25 Potential problem analysis ER diagram is shown in Fig. 41. POTENTIAL PROBLEM 660, SERIOUSNESS 664, and PROBABILITY 662 are stored in SPECIFICATION entity 666. LIKELY CAUSES 668 are stored in CAUSE entity 670. PREVENTATIVE ACTIONS 672 are stored in PREVENT ACTION
30 entity 674. CONTINGENT ACTIONS 676 are stored in CONTINGENCY ACTION 678 entity, and corresponding TRIGGERS 680 are stored in TRIGGER entity 682.

Potential opportunity analysis ER diagram is shown in Fig. 41a, and is similar in structure to the potential
35 problem analysis ER diagram shown in Fig. 41. Potential opportunity 660a, benefit 664a, and probability 662a are

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stored in SPECIFICATION entity 666a. Likely causes 668a are stored in CAUSE entity 670a. PROMOTING ACTIONS 672a are stored in PROMOTE ACTION entity 674a. Capitalizing actions 676a are stored in CAPITALIZING ACTION 678a entity, and corresponding triggers 680a are stored in TRIGGER entity 682a.

Fig. 42 shows the action tracker ER diagram. CONCERNS 684, SERIOUSNESS 686, URGENCY, 688, GROWTH 690, and PRIORITY 692 are stored in CONCERNS entity 694. ACTIONS 696, WHO 698, WHEN 700, NOTES 704, and STATUS 702 are stored in ITEMS entity 706.

The knowledge base as described above is populated with cells entered in the corresponding process screen sequences. This knowledge base may be queried during current process screen sequences to draw upon knowledge obtained from prior process screen sequences. Such queries and reports are through a standard SQL interface, and may be broad report-based statistical information, or specific keyword queries to pinpoint a specific process screen sequence. Such keyword queries are facilitated by the use of a master keyword table. Prior to saving any of the process screen sequences as defined herein, process records are parsed for occurrences of new keywords. New keywords not previously entered are displayed to the user, who is prompted to enter, categorize, and create associations for the keywords in the master keyword table.

These queries and reports may be predetermined, to address periodic status items such as displaying all unresolved problem analysis, or to list all decisions concerning a particular product line, or may be individual point-and-click queries using the individual knowledge base fields. An integrated database engine such as ORACLE® provides initial support for the knowledge base, however other database engines using SQL or other query language could be employed in alternative implementations or to customize an application to a particular user.

CLASS HIERARCHY

The class inheritance graphs of the complex situation assessment application as defined herein are shown in Figs. 43-48. Where applicable, connection links (A)-(N) are shown with the respective circled capital letters to indicate multiple sheet graphs.

The general process screen sequence class inheritance graph 800 is shown in Fig. 43. This graph defines the general process class common to the process screen sequences defined above. Situation appraisal inheritance graph is shown on Figs. 44a-44c. Situation class 802 is derived from the general process class, and manipulates situation background and general information. Concerns are manipulated by initial CONCERNS class 804 and REFINED CONCERNS class 806. Analysis needed is manipulated by SPECIFICATION class 808.

Referring to Figs. 45a-45d, the problem analysis inheritance graph is shown. PROBLEM ANALYSIS analysis class 810 is derived from the general PROCESS class 800 (Fig. 43). INITIATING DATA class 812 manipulates the problem object and the problem deviation. Test against SPECIFICATION class 814 manipulates is/is not information. POSSIBLE CAUSE class 816 manipulates possible causes. Changes and distinctions are handled by DISTINCTION/CHANGES pairs class 818.

Decision analysis process screen sequence class inheritance graph is shown in Fig. 46. DECISION ANALYSIS class 824 is derived from the general process class (800, Fig. 43). Objectives are manipulated by DECISION ANALYSIS OBJECTIVES class 818. Alternatives are handled by DECISION ANALYSIS ALTERNATIVES class 820. Adverse consequences are manipulated by DECISION ALTERNATIVES RISK class 822.

Fig. 47 shows the class inheritance graph for the potential problem analysis screen sequence. POTENTIAL PROBLEM ANALYSIS class 826 is derived from the general

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